

## WHAT IS CLAIMED IS:

1. An optical transmission system with optical amplifier repeaters, comprising:

a plurality of repeaters each of which has a plurality of pumping light sources and outputs a pumping light with a different  
5 pumping wavelength spectrum to achieve a different gain spectrum; and  
an optical fiber transmission line for Raman amplification;  
wherein:

the repeaters are located in a predetermined gain control zone allocated to the optical fiber transmission line.

2. An optical transmission system with optical amplifier repeaters as claimed in claim 1, wherein:

a plurality of gain control zones each having approximately the same length is allocated to the whole of the optical fiber transmission  
5 line.

3. An optical transmission system with optical amplifier repeaters as claimed in claim 1, wherein:

at least one gain control zone is allocated to the optical fiber transmission line.

4. An optical transmission system with optical amplifier repeaters as claimed in claim 1, wherein:

the pumping wavelength spectrum from each repeater is determined so that a total gain spectrum obtained by Raman  
5 amplification using a total pumping wavelength spectrum made of the different pumping wavelength spectra within one gain control zone becomes flatter than a gain spectrum obtained by Raman amplification using a single pumping wavelength spectrum from each repeater.

5. An optical transmission system with optical amplifier repeaters as claimed in claim 1, including:

an optical source failure monitoring section for detecting an occurrence of a failure in at least one of the pumping light sources; and

5 a gain spectrum compensating section for, when the optical source failure monitoring section detects a failure, compensating a distortion in a gain spectrum caused by the failure.

6. An optical transmission system with optical amplifier repeaters as claimed in claim 1, wherein:

each of the repeaters includes:

5 at least one pair of polarized wave pumping light sources which output pumping lights having the same wavelength; and

a polarized wave synthesizing section for synthesizing polarized waves of the pumping lights from the pair of the polarized wave pumping light sources.

7. An optical transmission system with optical amplifier repeaters as claimed in claim 6, including:

5 a gain spectrum compensating section for, when a failure occurs in an output of the pumping light from either of the polarized wave pumping light sources in the pair, compensating a distortion of a gain spectrum caused by the failure by controlling an output from the other polarized wave pumping source.

8. An optical transmission system with optical amplifier repeaters, comprising:

an optical fiber transmission line;

a plurality of Raman amplification optical fibers;

5           a plurality of optical amplifier repeaters; and  
          a gain control device; wherein:  
          the respective optical amplifier repeaters include a plurality of  
pumping light sources;

          the respective optical amplifier repeaters are located in the  
10   optical fiber transmission line at intervals, and supply pumping lights  
from the plural pumping light sources to the corresponding Raman  
amplification optical fibers; and

          the gain control device includes:

          a gain characteristic determining section for inputting  
15   therein signal lights transmitted via the optical amplifier repeaters to  
determine gain characteristics in a frequency range required for  
transmitting all of the signal lights; and

          a power adjustment instructing section for, when the  
gain characteristic determining section determines that predetermined  
20   gain characteristics have not been obtained, instructing an optical  
amplifier repeater, which includes a pumping light source for outputting  
a pumping light required for achieving the gain characteristics, from  
among the plural optical amplifier repeaters to adjust the power of the  
optical amplifier repeater.

9.   An optical transmission system with optical amplifier  
repeaters as claimed in claim 8, wherein:

          the gain control device further includes a plurality of pumping  
light sources each of which outputs a pumping light having a different  
5   wavelength, wherein:

          when the gain characteristic determining section determines  
that predetermined gain characteristics have not been obtained, the  
power adjustment instructing section instructs a power source for  
outputting a pumping light required for achieving the gain characteristics

- 10 from among the plural pumping light sources to adjust the power of the pumping light source.

10. An optical transmission system with optical amplifier repeaters as claimed in claim 8, wherein:

- each of the optical amplifier repeaters includes an optical circulator for inputting in the optical amplifier main signals transmitted  
5 via the optical fiber transmission line, and outputting the pumping lights from the plural pumping light sources to the optical fiber transmission line in the direction opposite to the direction where the main signals proceed.

11. An optical transmission system with optical amplifier repeaters as claimed in claim 9, wherein:

- each of the optical amplifier repeaters includes an optical circulator for inputting in the optical amplifier main signals transmitted  
5 via the optical fiber transmission line, and outputting the pumping lights from the plural pumping light sources to the optical fiber transmission line in the direction opposite to the direction where the main signals proceed.